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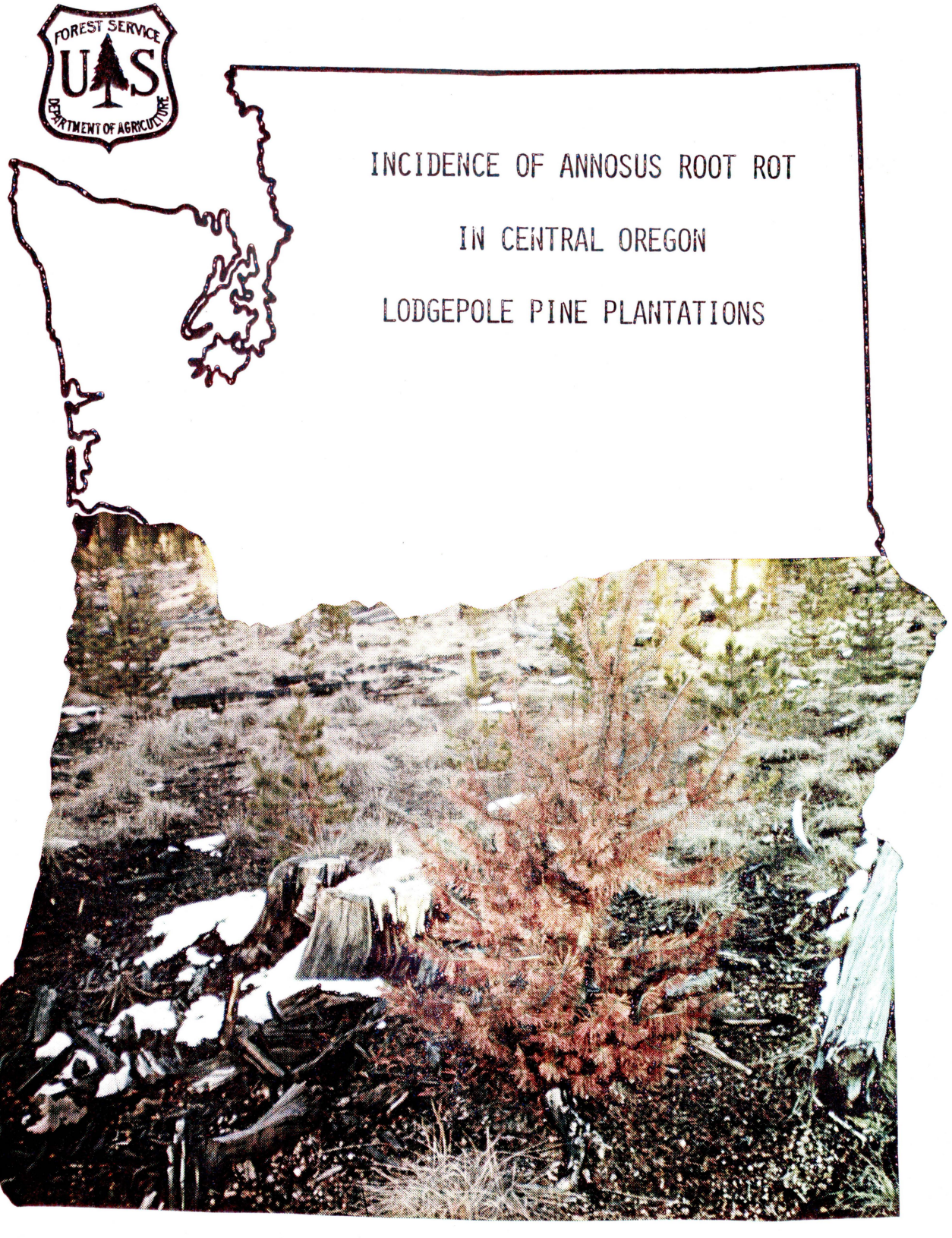
Forest Pest Management
Pacific Northwest Region



INCIDENCE OF ANNOSUS ROOT ROT IN CENTRAL OREGON LODGEPOLE PINE PLANTATIONS

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by

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Introduction

Lodgepole pine, *Pinus contorta* Dougl., is the predominant tree species over much of the Central Oregon Plateau. This area includes the Deschutes, Fremont and Winema National Forests, the Prineville District Bureau of Land Management, and State and private forests.

Harvesting of lodgepole pine in this area has increased substantially in recent years due to greater demand for small size sawlogs and salvaging of bark beetle-threatened and killed timber.

Lodgepole pine plantations developing on harvested sites are subject to disease-induced mortality caused by various pathogens, including *Fomes annosus* (Fr.) Cke.

Fomes annosus is known to cause mortality of several pine species in Oregon and California plantations (Olson, 1941; Johnson and Harvey, 1974; Bega and Smith, 1966). This fungus spreads long distances via airborne spores that infect through freshly cut stump surfaces and wounds. When environmental conditions allow stump colonization, the fungus can grow throughout the root system, infecting adjacent host trees via root contacts (Powers and Hodges, 1970). The fungus can survive in subterranean stump and root tissues for several years and infect susceptible roots that come into contact with them.

Fomes annosus has been found infecting ponderosa pine (*Pinus ponderosa* Laws.) stumps in thinned stands (Thies, 1979; Russell et al, 1973) in Oregon and Washington. While lodgepole pine is known to host this pathogen (Hepting 1971), little is known of its extent or severity in harvest units regenerated with this species in central Oregon.

To better understand what level of impact *F. annosus* is causing in lodgepole pine plantations in central Oregon, a disease survey was made during the 1981 field season. The objective of this survey was to:

Determine if *F. annosus* is causing mortality in central Oregon lodgepole pine plantations and, if so, determine:

a. what level of impact is occurring and
b. where the "problem" areas within the Central Oregon Plateau region are located.

Methods

Stand Selection

Candidate stands for sampling were selected randomly from identified lodgepole pine plantations in the Central Oregon Plateau. Central Oregon lodgepole pine plantations meeting specified criteria were identified from TRI System records, contacting District silviculturists, and making observations during field travel.

Candidate plantations had to meet the following criteria:

(1) Major species lodgepole pine
(2) Stand age 5-21 years
(3) Stand originated following a clearcut harvest

Sample stands were selected to provide maximum geographic coverage.

Determining Stand Parameters

Acreages of the sampling units surveyed were determined either from TRI System records, estimated from resource maps, or traversed using pacing and hand compass. Stand age was determined by counting whorls on several larger trees within each unit. Stocking levels were estimated by making tree counts in 10 fixed-area (1/100 acre) plots placed at 2-chain intervals along transect line(s) randomly placed within the stand.

Survey Procedure

Stands to be evaluated were entirely surveyed or subsampled depending on acreage and other factors. Larger stands were arbitrarily divided and a 5-10 acre subunit was surveyed.

Areas examined were surveyed 100 percent for disease centers. This was accomplished by walking parallel transect lines through the stand at intervals which enabled complete visual surveillance of trees within a strip on either side of lines. Some overlap was required to minimize missing dead or dying trees. Distances between transect lines varied between 30 and 100 feet, depending upon stand age and structure.

Disease centers were recognized by the presence of single or groups of dead and dying trees. From each disease center the following items of information were determined:

(1) Number of dead or symptomatic trees in the center
(2) Condition of each tree (dead or symptomatic)
(3) Approximate number of years since death for dead trees
(4) Suspected cause
(5) Diameter of the center (in feet). Size of single tree infection centers was determined by estimating or measuring crown width, which approximates rooting width. On trees too large to estimate crown width accurately, the following crown width formula was used:

$$CW = \frac{3.49 + 1.437\ D}{2}$$

where:

D = diameter breast height (inches)

CW = crown width (in feet)

(from Alexander et al, 1967)

Size of larger, multiple tree disease centers was determined by measuring the average center diameter between dead or symptomatic trees on the perimeter. Area in square feet was later determined for each disease center. Areas were calculated using the assumption that centers are generally circular.

Examination of Dead and Symptomatic Trees

Each dead or symptomatic tree in disease centers was examined for disease indicators including: mycelial fans and rhizomorphs of *Armillaria mellea*, ectotrophic mycelia of *Phellinus weirii*, sapwood stained black by *Ceratocystis* (Verticicladiella) *wageneri*, fruiting bodies of *Fomes annosus* (Plate 1) and the associated white stringy decay. Dead and symptomatic trees were also examined for indicators of other causes of mortality such as insect or rodent attacks or poor planting procedure. A 6-inch section of root or tissue from the root collar was collected from many of the dead and dying trees to confirm field diagnosis, and from all trees for which the identity of the causal organism could not be confidently made in the field.

Following field collection of diseased and suspected diseased material, tissue cultures and incubations were done to confirm the presence and identity of pathogens. Tissue cultures were made by splitting samples, aseptically removing 3-6 wood chips, and placing them on Petri dishes of 2% malt agar. Specimens were then wrapped in damp newspaper, placed in plastic bags, and incubated at ambient temperature. After approximately 2 weeks, cultures and incubated material were examined under 10-30X magnification for sporulation of *Oedocephalum* conidiophores, fungal structures diagnostic for *F. annosus*. Cultures from trees which did not yield *F. annosus* were examined for other root pathogens.

Results and Discussion

Lodgepole pine mortality caused by *F. annosus* was found in eleven (58%) of the nineteen stands surveyed. Three of seven stands on the Deschutes NF and eight of twelve stands on the Winema NF had *F. annosus*-caused mortality

Plate 1. *Fomes annosus* conks at base of ponderosa pine (duff layer removed).

(Figure 1 and Table 1). Minor amounts of *A. mellea* and an unknown root rot-induced mortality were found on four stands in the Deschutes NF (Figure 1 and Table 2). A total of 287 acres were surveyed.

Both single and multiple tree annosus root rot infection areas were detected. Infection centers were almost always associated with old stumps from which *F. annosus* had probably spread.

Total area infected was 24,177 ft^2 (0.56 acres). This acreage amounts to 0.2% of the total area surveyed and 0.3% of the area included in stands found to have some *F. annosus* infection. Stands 17, 14, 10 and 5 had the highest levels of *F. annosus*, with 3.04%, 0.66%, 0.36%, and 0.25% of their total area infected, respectively (Table 2).

Other damaging agents encountered resulted in minor impact. Pocket gopher damage was found in four stands. Poor planting practices, primarily J-rooting, were found at very low levels in two stands. A variety of unidentified factors caused minor mortality in nine of the stands surveyed.

The impact that annosus root rot will cause over the rotation of these stands is not known. Total area infected, however, will probably increase due to the ability of the fungus to persist for many years in large stumps and roots, and infect roots coming into contact with this inoculum. Roots of recently infected trees increase the level of inoculum in the soil facilitating spread of this fungus. Many existing infection centers will probably enlarge. Some will die out. It is likely that more infection areas will appear in some of these stands as roots of regenerating trees contact inoculum. Many surveyed stands are overstocked, but this disease removes groups of trees and does not thin stands in a beneficial manner. General low levels of occurrence indicate that annosus root rot is not yet a serious problem in central Oregon lodgepole pine plantations.

It is highly likely the incidence of annosus root rot is going to increase in future lodgepole pine plantations because of (1) the expanded level of harvesting due to actual and anticipated tree killing by mountain pine beetle, thus creating stumps for infection courts and (2) the increase of *F. annosus* spores for infection. Amounts of spores are undoubtedly increasing as more stumps become infected and conks are produced.

During the survey I saw recently-established plantations where stumps had been removed. This is being done along with slash disposal to facilitate mechanical planting. Since stumps are the primary source of *F. annosus* infection in young stands, incidence of this disease should be low or nonexistent in plantations where this form of site preparation has been used. Damage from annosus root rot is probably too low, however, to justify stump removal solely on the basis of preventing this disease. For the same reason, stump treatment with borax to prevent infection is probably not warranted, except in high value areas such as campgrounds.

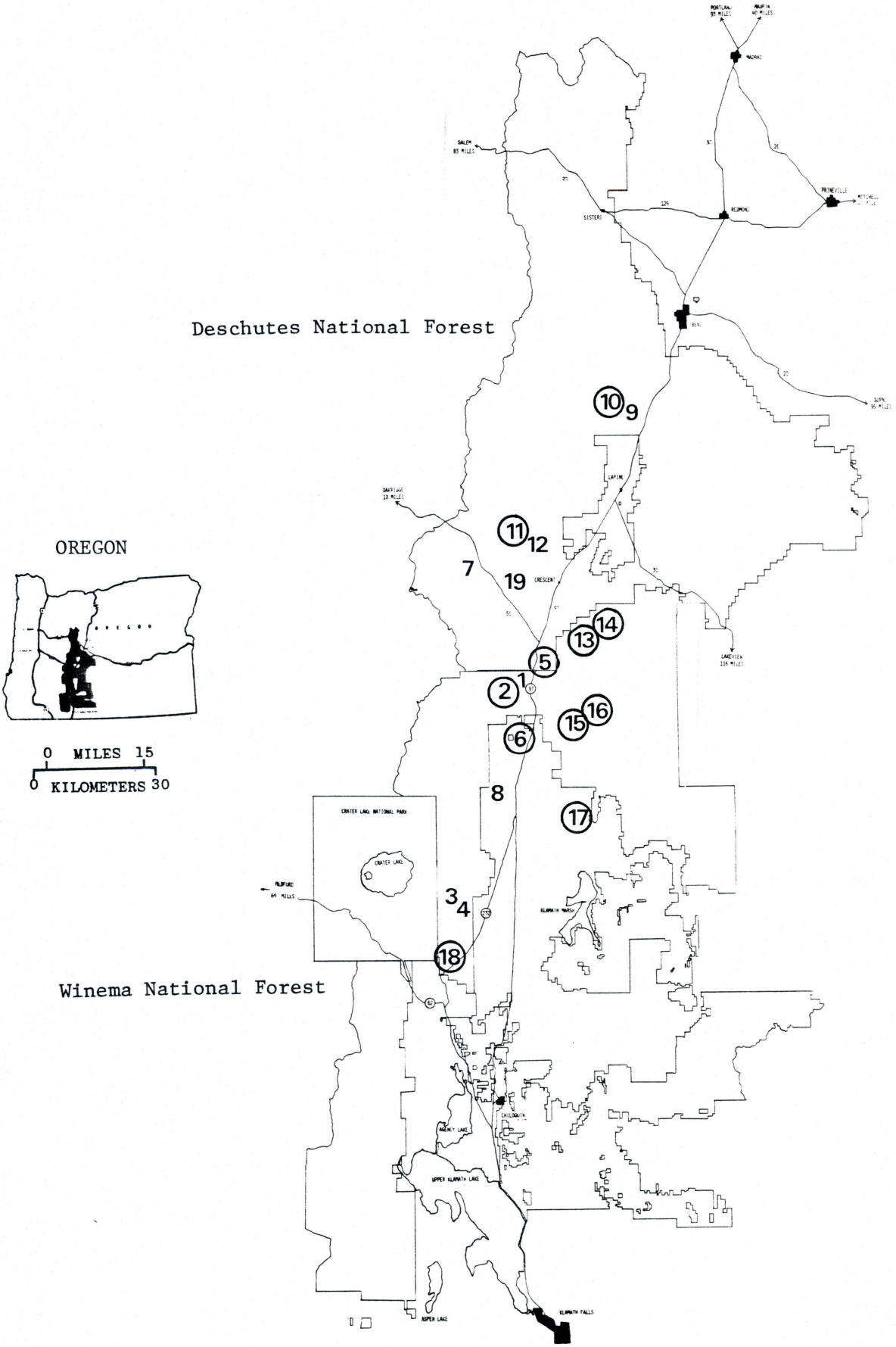

Figure 1. Location of Stands Surveyed for *Fomes annosus*. Stand numbers circled where *F. annosus* found.

Table 1--Stand Descriptions

Stand Number	Legal Description	Forest	Area Surveyed (Acres)	Stocking Level (T/A)	Age	Recently Thinned	Planted
1	T. 27 S., R. 8 E., Sec. 5	Winema	3	4,760	10		
2	T. 27 S., R. 8 E., Sec. 17	Winema	4	350	13		X
3	T. 32 S., R. 7½ E., Sec. 14	Winema	23	195	12	X	
4	T. 32 S., R. 7½ E., Sec. 14	Winema	26	222	12	X	
5	T. 26 S., R. 8 E., Sec. 33	Deschutes	86	700	10		X
6	T. 28 S., R. 8 E., Sec. 4	Winema	2	400	10		X
7	T. 24 S., R. 6½ E., Sec. 11	Deschutes	24	2,300	10		X
8	T. 29 S., R. 7 E., Sec. 7	Winema	2	1,200	8		
9	T. 20 S., R. 10 E., Sec. 12	Deschutes	16	80	10		X
10	T. 20 S., R. 10 E., Sec. 8 & 17	Deschutes	25	160	10		X
11	T. 23 S., R. 7 S., Sec. 15 & 16	Deschutes	11	260	12	X	X
12	T. 23 S., R. 7 S., Sec. 16	Deschutes	8	640	12		X
13	T. 26 S., R. 9 E., Sec. 16	Winema	6	2,600	10		
14	T. 26 S., R. 9 E., Sec. 9 & 10	Winema	10	2,960	12		
15	T. 27 S., R. 9 E., Sec. 27	Winema	4	2,780	8		
16	T. 27 S., R. 9 E., Sec. 23	Winema	5	1,700	8		
17	T. 29 S., R. 9 E., Sec. 17	Winema	5	680	10		X
18	T. 32 S., R. 7½ E., Sec. 11	Winema	18	690	19		
19	T. 24 S., R. 7 E., Sec. 11	Deschutes	9	1,467	5		X

Table 2--Stand disease, damage incidence and impact

	Fomes annosus				Other Mortality (No. trees)			
			Area Infected		*Armillaria*	Animal	Poor	
Stand Number	Infected Trees[a]	No. Centers	ft^2	% of total	*mellea*	damage	planting	unknown
1								8
2	3	3	26	.02				
3								
4								
5	57	31	9,325	.25	1	5	1	1
6	1	1	6	.01				
7					1		8	1
8								
9					1	4		
10	10	10	3,941	.36	1	6		5
11	7	4	697	.15				2
12						1		4
13	40	20	639	.24				
14	68	20	2,883	.66				2
15	3	3	10	.01				
16	4	2	16	.01				
17	41	14	6,628	3.04				3
18	6	5	6	.00				11
19					1			

[a] includes dead and dying

Conclusions

Fomes annosus was found killing trees throughout the Central Oregon Plateau in young lodgepole pine plantations, but at generally low levels. Of nineteen stands surveyed, one has had 3.04% of its total area in production reduced by formation of root rot centers of this pathogen. Ten other stands were found to have much lower levels of infection, with 0.66% to less than 0.001% of their area infected with *F. annosus*. Direct control of annosus root rot, except for special circumstances, is not warranted because of the small losses.

Literature Cited

Alexander, R. R., D. Tackle, and W. G. Dahms
1967. Stand indexes for lodgepole pine, with corrections for stand density: methodology. USDA Forest Service Research Pap. RM-29. Rocky Mtn. Range and Exp. Sta., Ft. Collins, CO.

Bega, R. V. and R. S. Smith, Jr.
1966. Distribution of *Fomes annosus* in natural forests of California. Plant Disease Reporter 50:832-836.

Hepting, G. H.
1971. Diseases of forest and shade trees of the United States. USDA Forest Service. Agriculture Handbook No. 386.

Johnson, D. W., and R. H. Harvey
1974. Biological evaluation of *Fomes annosus* root rot in a ponderosa pine-Jeffrey pine plantation. Fremont National Forest, Oregon. USDA Forest Service. Region 6, Timber Management Report.

Olson, A. J.
1941. A root disease of Jeffrey and ponderosa pine reproduction. Phytopathology 31:1063-1077.

Powers, H. R. and C. S. Hodges, Jr.
1970. Annosus root rot in eastern pines. USDA Forest Service Forest Pest Leaflet No. 76, 8 p.

Russell, K. W., R. E. Wood, and C. H. Driver
1973. *Fomes annosus* stump infection in ponderosa pine sapling stands of eastern Washington. State of Washington DNR Report No. 27.

Thies, W. G.
1979. Frequency of pine stump colonization by *Fomes annosus* on the Fremont National Forest. Plant Disease Reporter 63:542-545.

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